OSPF DR and BDR Elections

In Chapter 6, "Enhanced IGRP (EIGRP) and Open Shortest Path First (OSPF)," of the Sybex *CCNA Study Guide* Standard and *CCNA Study Guide* Deluxe Editions, I discussed EIGRP and OSPF in detail. But I'd really like to expand the section on designated routers and backup designated routers. I'd also like to delve deeper into verifying the election process and provide you with a hands-on lab to help you understand that process even better!

To start with, I need to make sure you fully understand the terms *neighbors* and *adjacencies* because they're really crucial to the DR and BDR election process. The election process happens when a broadcast or nonbroadcast multi-access network is connected together. (Think Ethernet or Frame Relay.)

Finally, I'm going to end this OSPF update section with a hands-on lab that's critically important for you to understand the OSPF designated router (DR) and backup designated router (BDR) election process.

Neighbors

Routers that share a common segment become neighbors on that segment. These neighbors are elected via the Hello protocol. Hello packets are sent periodically out of each interface using IP multicast.

Two routers won't become neighbors unless they agree on the following:

Area-ID The idea here is that the two routers interfaces have to belong to the same area on a particular segment. And of course, those interfaces have to belong to the same subnet.

Authentication OSPF allows for the configuration of a password for a specific area. Although authentication between routers isn't required, you have the option to set it if you need to do so. Also, keep in mind that in order for routers to become neighbors, they need to have the same password on a segment if you're using authentication.

Hello and Dead Intervals OSPF exchanges Hello packets on each segment. This is a keepalive system used by routers to acknowledge their existence on a segment and for electing a designated router (DR) on both broadcast and nonbroadcast multi-access segments.

The Hello interval specifies the amount of seconds between Hello packets. The Dead interval is the number of seconds that a router's Hello packets can go without being seen before its neighbors declare the OSPF router dead (down). OSPF requires these intervals to be exactly the same between two neighbors. If any of these intervals are different, the routers won't become neighbors on that segment. You can see these timers with the `show ip ospf interface` command.

Adjacencies

In the election process, adjacency is the next step after the neighboring process. Adjacent routers are routers that go beyond the simple Hello exchange and proceed into the database exchange process. In order to minimize the amount of information exchanged on a particular segment, OSPF elects one router to be a designated router (DR) and one router to be a backup designated router (BDR) on each multi-access segment.

The BDR is elected as a backup router in case the DR goes down. The idea behind this is that routers have a central point of contact for information exchange. Instead of each router exchanging updates with every other router on the segment, every router exchanges information with the DR and BDR. The DR and BDR then relay the information to everybody else.

DR and BDR Elections

DR and BDR election is accomplished via the Hello protocol. Hello packets are exchanged via IP multicast packets on each segment.

However, only segments that are broadcast and nonbroadcast multi-access networks (examples are Ethernet and Frame Relay) will perform DR and BDR elections. Point-to-point links, like a serial WAN for example, will not have a DR election process.

On a broadcast or nonbroadcast multi-access network, the router with the highest OSPF priority on a segment will become the DR for that segment. This priority is shown with the `show ip ospf interface` command.

The default priority for a router interface is one. If all routers have the default priority set, the router with the highest Router ID (RID) will win.

The RID is determined by the highest IP address on any interface at the moment of OSPF startup. This can be overridden with a loopback (logical) interface.

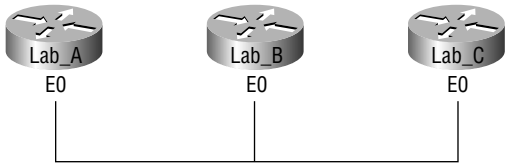
If you set a router's interface to a priority value of zero, that router won't participate in the DR or BDR election on that interface. The state of the interface with priority zero will then be DROTHER.

Hands-on Lab: OSPF DR and BDR Elections

In this lab, you'll watch the DR and BDR elections on your test network by forcing and verifying the election process. You're going to start by using Figure 1.1 to build your network. The more routers you have the better, but you need at least three routers connected via a LAN segment to complete this lab.

In this lab, I am using 2500 series routers, but you can use any type of router with any type of LAN interface. In addition, the RouterSim 4.1 program can also run this lab.

FIGURE 1.1 OSPF Hands-on Lab network diagram



1. First, connect the network together as shown in Figure 1.1. Create an IP scheme for the network—something simple like `10.1.1.1/24`, `10.1.1.2/24`, and `10.1.1.3/24` will work great.
2. Now configure OSPF, and place all routers into area 0. Only the Ethernet LAN interface needs to be configured in this lab, because as you know, elections don't take place on serial connections.
3. Next, type **`show ip ospf interface e0`** on each router to verify area ID, DR, BDR information and the Hello and Dead timers of the interface connected to the LAN network
4. By looking at the **`show ip ospf interface e0`** output, determine which router is the DR and which router is the BDR.
5. Now verify the network type of your router. Because the connection is on an Ethernet LAN, the Network Type is BROADCAST. If you were viewing a serial connection, you'd want a point-to-point network.
6. Here you have to set the priority for the router. The priority of all routers, by default, is 1. If you were to change the priority to 0, the router would never participate in the election process for the LAN (remember that elections do not occur on serial point-to-point links).
7. Now you need to decide which router will be the new DR.
8. Next, enable the debugging process that allows you to see the DR and BDR election take place. Type **`debug ip ospf adjacency`** on all your routers.

Try and open more then one console connection by telnetting into the other routers. Remember to use the `terminal monitor` command on the telnet session or you won't see any debugging output!

9. Here, set the priority of the new DR Ethernet 0 interface to 3 by typing: **`ip ospf priority 3`**.
10. Next, shut down the Ethernet interface of the DR router and bring it back up with the **`no shutdown`** command. Obviously, if you're telnetted into that router, you'll lose your session at this point.

11. Here's where the election should take place and the router you picked to be the DR should now actually be the DR.
12. Finally, type **`show ip ospf interface e0`** to verify the DR and BDR information on each router.

The priority of a router's interface can be set all the way up to 255, which means it will always be the DR of the area. You can then set a router in your test network with a higher priority and see that the priority takes precedence over a high RID on a router, even if you are using a loopback (logical) interface.